

CLAIMS

1. A method of producing a three-dimensional structure, comprising the steps of: arranging a substrate close to a tip of a needle-shaped fluid-ejection
5 body, having a fine diameter, supplied with a solution; ejecting a fluid droplet having an ultra-fine diameter toward a surface of the substrate by applying a voltage having a prescribed waveform to the needle-shaped fluid-ejection body; making the droplet fly and land on the substrate; and solidifying the droplet after the fluid droplet is landed on the substrate.
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2. The method of producing a three-dimensional structure according to claim 1, wherein an electric field is focused at a solidified substance formed of previously landed droplet, and a subsequent droplet is stacked on said solidified substance.
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3. The method of producing a three-dimensional structure according to claim 1 or 2, wherein an electric field is focused at the top of a three-dimensional substance formed of the solidified substance of the droplet, and wherein the three-dimensional substance is grown by stacking the subsequent flying droplet
20 on the top of the three-dimensional substance.
4. The method of producing a three-dimensional structure according to any one of claims 1 to 3, wherein a cross-sectional diameter of the three-dimensional structure is controlled by a volatile property of the droplet ejected from the
25 needle-shaped fluid- ejection body.

5. The method of producing a three-dimensional structure according to any one of claims 1 to 4, wherein a temperature of the substrate is controlled in that the previously landed droplet on the substrate is volatilized to be hard enough for the subsequent droplet stacked thereon.

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6. The method of producing a three-dimensional structure according to any one of claims 1 to 5, wherein a surface temperature of the substrate is controlled by at least one heating means selected from the group consisting of a Peltier element, an electric heater, an infrared heater, a heater using fluid such as an oil
10 heater, a silicon rubber heater, and a thermistor, that is fixed to the substrate or a substrate supporting body.

7. The method of producing a three-dimensional structure according to any one of claims 1 to 6, wherein a surface temperature of the substrate is controlled
15 in a range of from room temperature to 100°C.

8. The method of producing a three-dimensional structure according to any one of claims 1 to 7, wherein the fluid is a solution containing metal particulates.

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9. The method of producing a three-dimensional structure according to any one of claims 1 to 7, wherein the fluid is a polymer solution.

10. The method of producing a three-dimensional structure according to any
25 one of claims 1 to 7, wherein the fluid is a solution containing ultra-fine ceramic

particles.

11. The method of producing a three-dimensional structure according to any one of claims 1 to 7, wherein the fluid is a sol-gel solution of ceramics.

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12. The method of producing a three-dimensional structure according to any one of claims 1 to 7, wherein the fluid is a low molecular weight compound solution.

10 13. The method of producing a three-dimensional structure according to any one of claims 1 to 7, wherein the fluid is a fluid containing at least one solution selected from the group consisting of a solution containing metal particulates, a polymer solution, a solution containing ultra-fine ceramic particles, a sol-gel solution of ceramics, and a low-molecular weight compound solution.

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14. The method of producing a three-dimensional structure according to any one of claims 1 to 13, wherein a diameter of the ejected droplet is 15 μm or less.

15. The method of producing a three-dimensional structure according to
20 claim 14, wherein a diameter of the droplet is 5 μm or less.

16. The method of producing a three-dimensional structure according to claim 14, wherein a diameter of the droplet is 3 μm or less.

25 17. The method of producing a three-dimensional structure according to any

one of claims 1 to 16, wherein a time required for the droplet to be dried and solidified is 2 seconds or less.

18. The method of producing a three-dimensional structure according to claim 17, wherein the time required for the droplet to be dried and solidified is 1 second or less.

19. The method of producing a three-dimensional structure according to claim 17, wherein the time required for the droplet to be dried and solidified is 0.1 second or less.

20. The method of producing a three-dimensional structure according to any one of claims 1 to 19, wherein a flying speed of the droplet is 4 m/sec or more.

21. The method of producing a three-dimensional structure according to claim 20, wherein the flying speed is 6 m/sec or more.

22. The method of producing a three-dimensional structure according to claim 20, wherein the flying speed is 10 m/sec or more.

23. The method of producing a three-dimensional structure according to any one of claims 1 to 22, wherein the steps are conducted in an atmosphere having a vapor pressure of the fluid lower than a saturated vapor pressure of the fluid.

24. The method of producing a three-dimensional structure according to any

one of claims 1 to 23, wherein a dielectric constant of the fluid to be ejected is 1 or more.

25. A three-dimensional structure having a fine diameter comprises droplets
5 having an ultra-fine particle diameter, wherein the structure is grown by solidifying the droplets and stacking the solidified droplets.

26. The three-dimensional structure according to claim 25, wherein an aspect
10 ratio of the structure is 2 or more.

27. The three-dimensional structure according to claim 26, wherein the aspect ratio of the structure is 3 or more.

28. The three-dimensional structure according to claim 26, wherein the
15 aspect ratio of the structure is 5 or more.

29. The three-dimensional structure according to any one of claims 25 to 28, wherein a particle diameter of the droplet is 15 μm or less.

20 30. The three-dimensional structure according to claims 29, wherein the particle diameter of the droplet is 5 μm or less.

31. The three-dimensional structure according to claim 29, wherein the particle diameter of the droplet is 3 μm or less.